IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Yaniv et al.	Art Unit	: 2879
Serial No.	: 10/765,623	Examiner	: Mariceli Santiago
Filed	: January 27, 2004	Conf. No.	: 1353
Title	: FIELD EMISSION DISPLAY USING CARBON NANOTUBES AND METHODS OF MAKING THE SAME		

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Commissioner for Patents
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SECOND SUPPLEMENTAL APPEAL BRIEF

This Supplemental Appeal Brief is submitted pursuant to the Notification of Non-Compliant Appeal Brief dated November 6, 2007.

I. REAL PARTY-IN-INTEREST

The real party-in-interest is Nano-Proprietary, Inc., which is the assignee of the entire right and interest in the present Application.

II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to Appellants, the Appellants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-9 and 11-12 are pending in the Application, and also stand rejected.

The rejections of claims 1-9 and 11-12 are appealed.

Claims 10 and 13-18 have been cancelled.

IV. STATUS OF AMENDMENTS

There were no amendments to the claims or Specification filed after the Final Rejection.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention as recited in claims 1 and 7 utilizes embossed microstructures within a substrate, such as illustrated in FIGURE 4. FIGURE 4 shows such embossed microstructure holes within a material. Embossing may utilize a metal die and counter along with heat and pressure to reshape the surface of a material (paper, plastic, metal, wood, etc.). The result is a three-dimensional design which creates a sense of depth and contrast. This is sometimes referred to as "stamping," but a roller can also emboss an image in a surface. Using embossing techniques, one can obtain a density of round openings of four or five holes in each ten micrometers, and the depth can be from very shallow to as deep as 20 to 30 micrometers. By properly selecting the length of the carbon nanotubes in coordination with the diameter of the opening and the depth, one can use a number of techniques that exploit the long and narrow shapes of the carbon nanotubes to be inserted into the embossed holes in such a way that all nanotubes in a hole will be more or less parallel to the long axis of the hole. [Page 3, line 14 - page 4, line 2].

FIGURE 1 illustrates the result of such a process. A substrate 100, which could be plastic, metal, semiconductor, glass, or any other type of solid material, has holes 102 embossed therein, and carbon nanotubes 101 have been deposited within each of the holes 102. A number of techniques can be utilized to direct the carbon nanotubes 101 into the embossed holes 102. For example: shaking, vibrations, carbon nanotubes in a solution, spraying, electrophoresis, magnetic fields, electric fields, etc. For example, a film of carbon nanotubes can be deposited over the embossed holes 102. Then, via shaking or vibration of the substrate 100, the long carbon nanotubes 101 will fall into the holes 102 lengthwise. [Page 4, lines 3-11].

Referring to FIGURE 2, the carbon nanotubes 201 can thereafter be fixed in the holes 202 with a solution 204 that partially fills each hole 202. The carbon nanotubes within each of the holes can then be cross-linked, for example by utilizing ultra violet energy, heat, or other means. [Page 4, lines 12-15].

FIGURE 2 also illustrates how to make a field emission cathode using such a technique. On top of a substrate 200, a metal layer 203 is deposited. Then a dielectric material 205 is deposited on the metal layer 203, and holes 202 are embossed within the dielectric substrate 205. The carbon nanotubes 201 are deposited within each of the holes 202 so that they come in physical contact with the metal layer 203. A material 204 can be used to fix the carbon nanotubes 201 within each of the holes 202. [Page 4, lines 16-22].

Referring to FIGURE 3, a conductive gate layer 301 can then be deposited on the structure shown in FIGURE 2, and an anode 302 comprising a substrate 303, an indium tin oxide (ITO) layer 304 and a phosphor 305, can be positioned over the cathode. An electric field can be created between the cathode and the anode by connecting a voltage potential between the ITO layer 304 and the conductive layer 203. Emission from carbon nanotubes 201 within selected holes 202 can then be accomplished by varying a threshold voltage between the ITO layer 304 and the gate electrode 301. Matrix addressable structure, commonly known in the field emission art, such as perpendicular addressable anode and cathode (or grid) electrodes, can be utilized to cause electron emission from carbon nanotubes within very specific areas, resulting in the creation of addressable pixels. [Page 4, line 23 - page 5, line 4].

Further with respect to claim 7, FIGURE 5 shows a display 538 in a data processing system 513 with elements as recited in claim 7. Display 538 includes the substrate and carbon nanotubes as noted above [Page 5, lines 8-23].

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over *Park et al.* (U.S. Patent No. 6,019,656).

2. Claim 1 stands rejected under 35 U.S.C. § 102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over *Imai et al.* (U.S. Patent No. 6,653,366).

3. Claims 1-6 stand rejected under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over *Nakamoto* (U.S. Patent No. 6,097,138).

4. Claims 7-9 and 11-12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Yaniv et al.* (U.S. Patent No. 6,312,303) in view of *Nakamoto*.

VII. ARGUMENTS

1. Claim 1 stands rejected under 35 U.S.C. §102(b) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over *Park et al.* (U.S. Patent 6,019,656). Applicants respectfully traverse these rejections.

A claim is anticipated only if every element as set forth in the claim is found in a single prior art reference. MPEP § 2131. There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 1576 (Fed. Cir. 1991). Furthermore, an applicant is entitled to be his or her own lexicographer and may rebut the presumption that claim terms are to be given their ordinary and customary meaning by clearly setting forth a definition of the term that is different from its ordinary and customary meaning(s). MPEP §2111. Where an explicit definition is provided by the applicant for a term, that definition will control interpretation of the term as it is used in the claim. *Toro Co. v. White Consolidated Industries Inc.*, 199 F.3d 1295, 1301, 53 USPQ2d 1065, 1069 (Fed. Cir. 1999). The Detailed Description of the specification recites: "Embossing may utilize a metal die and

counter along with heat and pressure to reshape the surface of a material (paper, plastic, metal, wood, etc.). This is sometimes referred to as 'stamping,' but a roller can also emboss an image in a surface."

Regarding claim 1, the Examiner states "*Park* discloses an apparatus comprising a substrate (11) with holes therein, and carbon nanotubes (13) deposited in the empty holes (Fig. 1A-1C)."

The Examiner has noticeably deleted her previous assertion that the prior art discloses "embossed" holes. [Compare Final Rejection dated 9/22/05 to Office Action dated 5/3/05.] As such, Applicants respectfully assert that the Examiner is admitting that the prior art does not disclose or suggest "embossed holes."

Instead, the Examiner is now asserting in the Final Rejection that the term "embossed" can be ignored, since it merely describes the process by which the product is made.

The problem with the Examiner's assertions is that the claims directly recite "carbon nanotubes deposited in ... embossed holes" (emphasis added). Since the Examiner now admits that such embossed holes are not disclosed in the prior art, the Examiner's rejections fail. To reiterate, *Park et al.* do not disclose the embossing of holes in a substrate. *Park et al.* teach "a micro-array structure of holes is fabricated by forming a micro-sized holes on the silicon substrate by an etching process." *Park et al.*, col. 2, lines 12-15. An etching process is commonly known by one of ordinary skill in the art to mean removal of material using a process based on a chemical reaction. The Applicants' definition of embossing clearly refers to a mechanical alteration using heat and pressure. The distinction in the process used to manufacture the apparatus in claim 1 is significant inasmuch as mechanical embossing can be practiced on a wider range of substrate materials and allows more flexibility and precision in the geometry of the hole and the pitch of the pattern.

Applicants respectfully assert that the Examiner has not established a *prima facie* case that claim 1 is anticipated or obvious since *Park et al.* do not disclose or suggest every limitation of claim 1. Therefore, claim 1 is patentable over *Park et al.*

2. Claim 1 stands rejected by the Examiner under 35 U.S.C. §102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over *Imai et al.* (U.S. Patent 6,653,366).

A claim is anticipated only if every element as set forth in the claim is found in a single prior art reference. MPEP § 2131. There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 1576 (Fed. Cir. 1991). Furthermore, an applicant is entitled to be his or her own lexicographer and may rebut the presumption that claim terms are to be given their ordinary and customary meaning by clearly setting forth a definition of the term that is different from its ordinary and customary meaning(s). MPEP §2111 Where an explicit definition is provided by the applicant for a term, that definition will control interpretation of the term as it is used in the claim. *Toro Co. v. White Consolidated Industries Inc.*, 199 F.3d 1295, 1301, 53 USPQ2d 1065, 1069 (Fed. Cir. 1999). The Detailed Description of the specification recites: "Embossing may utilize a metal die and counter along with heat and pressure to reshape the surface of a material (paper, plastic, metal, wood, etc.). This is sometimes referred to as "stamping," but a roller can also emboss an image in a surface."

Regarding claim 1, the Examiner states "*Imai* discloses an apparatus comprising a substrate (11) with holes (12) therein, and carbon nanotubes (13) deposited in the empty holes (Fig. 3A)."

The Examiner has noticeably deleted her previous assertion that the prior art discloses "embossed" holes. Compare Final Rejection dated 9/22/05 to Office Action dated 5/3/05. As such, Applicants respectfully assert that the Examiner is admitting that the prior art does not disclose or suggest "embossed holes."

Instead, the Examiner is now asserting in the Final Rejection that the term "embossed" can be essentially ignored, since it merely describes the process by which the product is made.

The problem with the Examiner's assertions is that the claims directly recite "carbon nanotubes deposited in ... embossed holes" (emphasis added). Since the

Examiner now admits that such embossed holes are not disclosed in the prior art, the Examiner's rejections fail. To reiterate, *Imai et al.* do not disclose the embossing of holes in a substrate. *Imai et al.* teach "applying a resist and forming a pattern in accordance with the layout of the electron-emitting portions 103 by lithography." *Imai et al.*, col. 1, line 66 to col. 2 line 1. A lithography process is commonly known by one of ordinary skill in the art to mean removal of material using an etching process based on a chemical reaction. The Applicants' definition of embossed clearly refers to a mechanical alteration using heat and pressure. The distinction in the process used to manufacture the apparatus in claim 1 is significant inasmuch as mechanical embossing can be practiced on a wider range of substrate materials and allows more flexibility and precision in the geometry of the hole and the pitch of the pattern.

Further in regard to claim 1, *Imai et al.* do not teach depositing carbon nanotubes in the holes. *Imai et al.* disclose the use of carbon ink with an organic binder and a solvent, in which the carbon particles are selected from at least one of carbon nanotubes, graphite, and carbon fibers made into carbon powder. *Imai et al.*, col. 18, claims 1 and 3. *Imai et al.* teach that the carbon nanotubes are pulverized and used for the carbon particles in the carbon ink. *Imai et al.*, col. 10, lines 32-33. In their detailed description of Fig. 3A, *Imai et al.* disclose filling the concave portions (12) with carbon ink (13). *Imai et al.*, col. 12, line 64 to col. 13 line 3. Applicants respectfully assert that the device disclosed by *Imai et al.* is patentably distinct from "a substrate with holes embossed therein with a die; and carbon nanotubes deposited in the empty embossed holes." as in amended claim 1.

Applicants respectfully assert that the Examiner has not established a *prima facie* case that claim 1 is anticipated or obvious since *Imai et al.* do not disclose or suggest every limitation of claim 1. Therefore, claim 1 is patentable over *Imai et al.*

3. Claims 1-6 stand rejected under 35 U.S.C. § 102(e) as being anticipated by, or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over *Nakamoto*. Applicants traverse.

Regarding claim 1, the Examiner states "*Nakamoto* discloses an apparatus comprising a substrate (52) with holes therein, and carbon nanotubed [sic] (1b) deposited in the empty holes (Figs. 8A-8C1)."

The Examiner has noticeably not asserted that the prior art discloses "embossed" holes. As such, Applicants respectfully assert that the Examiner is admitting that the prior art does not disclose or suggest "embossed holes."

Instead, the Examiner is asserting in the Final Rejection that the term "embossed" can be essentially ignored, since it merely describes the process by which the product is made.

The problem with the Examiner's assertions is that the claims directly recite "carbon nanotubes deposited in ... embossed holes" (emphasis added). *Nakamoto* merely utilizes lithography etching techniques to form recesses in which nanotubes are grown. These recesses are not embossed holes. Since the Examiner now admits that such embossed holes are not disclosed in the prior art, the Examiner's rejections fail.

Claim 2 depends from claim 1. Claims 4-6 depend directly or indirectly from claim 2. For at least the reasons discussed above with respect to claim 1, claims 2-6 are patentable over *Nakamoto*.

4. Claims 7-9 and 11-12 stand rejected by the Examiner under 35 U.S.C. §103(a) as being unpatentable over *Yaniv et al.* (U.S. Patent 6,312,303) in view of *Nakamoto*.

The basic test for nonobvious subject matter is whether the differences between the subject matter and the prior art are such that the claimed subject matter as a whole would not have been obvious to a person having ordinary skill in the art to which the subject matter pertains. MPEP §2141.

Regarding claim 7, the Examiner admits that *Yaniv et al.* "fail to disclose the display device comprising a substrate with holes therein, and carbon nanotubes deposited in the empty holes."

The Examiner has noticeably not asserted that *Yaniv et al.* discloses "embossed" holes. *Nakamoto* merely utilizes lithography etching techniques to form recesses in which nanotubes are grown.

The Examiner is now asserting in the Final Rejection that the term "embossed" can be essentially ignored, since it merely describes the process by which the product is made.

The problem with the Examiner's assertions is that the claims directly recite "carbon nanotubes deposited in ... embossed holes" (emphasis added). Since the Examiner now admits that such embossed holes are not disclosed in the prior art, the Examiner's rejections fail. One skilled in the art at the time the invention was made would not have arrived at the claimed invention in view of the combination of *Yaniv* and *Nakamoto*. These recesses are not embossed holes.

Claim 8 depends from claim 7; claim 9 depends from claim 8; claim 11 depends from claim 9; and claim 12 depends from claim 11. Claims 8-9 and 11-12 thus depend directly or indirectly from claim 7. For at least the reasons discussed above with respect to claim 7, claims 8-9 and 11-12 and 4-6 are patentable over *Yaniv et al.* in view of *Nakamoto*.

Respectfully submitted,

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CLAIMS APPENDIX

1. An apparatus comprising:

a substrate with holes embossed therein with a die; and

carbon nanotubes deposited in the empty embossed holes.

2. The apparatus as recited in claim 1, further comprising:

a conductive layer within the substrate electrically connecting at least a portion of the carbon nanotubes within a plurality of the holes.

3. The apparatus as recited in claim 2, further comprising:

a gate electrode coextensive with the substrate.

4. The apparatus as recited in claim 2, a material for affixing the carbon nanotubes within the holes.

5. The apparatus as recited in claim 3, further comprising:

an anode positioned a distance from the substrate, having a cathodoluminescent material for emitting photons in response to bombardment from electrons emitted by the carbon nanotubes.

6. The apparatus as recited in claim 5, further comprising:

circuitry for causing the electrons to be emitted by the carbon nanotubes.

7. A data processing system comprising:

a processor;

a memory device;

a storage device;

an input device;

a display device; and

a bus system for coupling the processor to the memory device, the storage device, the input device, and the display device, wherein the display device further comprises:

a substrate with holes embossed therein with a die; and

carbon nanotubes deposited in the empty embossed holes.

8. The data processing system as recited in claim 7, further comprising:

a conductive layer within the substrate electrically connecting at least a portion of the carbon nanotubes within a plurality of the holes.

9. The data processing system as recited in claim 8, further comprising:

a gate electrode coextensive with the substrate.

11. The data processing system as recited in claim 9, further comprising:

an anode positioned a distance from the substrate, having a cathodoluminescent material for emitting photons in response to bombardment from electrons emitted by the carbon nanotubes.

12. The data processing system as recited in claim 11, further comprising:

circuitry for causing the electrons to be emitted by the carbon nanotubes.

EVIDENCE APPENDIX

No evidence was submitted pursuant to §§1.130, 1.131, or 1.132 of 37 C.F.R. or of any other evidence entered by the Examiner and relied upon by Appellants in the Appeal.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings to the current proceeding.